Management and Recycling Routes in Plastic Waste Management Framework: A World Prospective

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Abstract

Plastic waste management faces severe challenges and opportunities worldwide, regardless of their sustainability awareness and technological advances. In this paper, a better framework for plastic waste management and close loop recycling is proposed. A special emphasis is paid on functional analysis of recycling and utility of a cross functional team for plastic waste management. Paper also focuses on investigating the behaviour of stakeholders and factors that influence the techniques and management of the plastic waste but also the environmental, socio-economic, institutional and legal linkages present to enable the overall system to functioning.

Keywords

Plastic Waste; Framework; Close Loop Recycling; Fast Approach

Introduction

Plastic waste management systems are required to safeguard the public health, safety, and welfare. Several options available are for plastic waste management is landfilling, incineration, and recycling wastes into useful products. Due to increase urbanization the plastic materials are being extensively used for various applications because of its properties and generate lots of solid waste at the end of its lifetime (Siddique et al., 2008). There is no estimated data available on the total generation of the plastic waste in India, approximately 5.6 million tonnes of plastic waste generated annually which is 15342 tonnes per day. By the year 2030 it is estimated that approximately 20 million tonnes of plastic waste is generated in India (Panda Achyut K. et al. 2010).The major reason for the generation of huge quantity of plastic waste is the life duration of the plastic products. The minimum life period for low quality plastic products are one month only and for high quality products it ranges from 1 to 35 years (Achilias D.S.et al.

2007). Due to the cheaper price as compare to the other metals plastic is been widely by middle class community in India, thus it becomes third major consumer after china and USA (Panda Achyut K. et al. 2010). In India most of the products made after the recycling of the plastic waste having life of 8 years are being used (Achilias D.S.et al. 2007). Plastics waste recycling would not be successful unless the proper infrastructure to collect the waste is being set, the technology to economically reprocess the waste into new products is available, and the establishment of markets for the cost-effective use of recycled products is developed.

Due to the social and economic vulnerability aspects that are related to the plastic waste there is an urgent need to built strong management practices for handling plastic waste recycling in developing nations. The increasing awareness regarding sustainable waste management practices and in order to improve the existing practices of plastic waste recycling in India, this paper focuses the following objectives:

Section 1 of the paper provides a background of the recycling techniques for PW with special emphasis on the reduction of green house gases emission.

Section 2 focuses solely on the functional analysis aspect for successful recycling of PW but also by addressing the role of the expert, local and government agencies responsible for it.

Section 3 of the study proposes a model for recycling and reuse of the PW with the generation of cross functional team by considering all major aspects.

Net Reduction in Green House Gases Emission

Green House gas reduction can be minimized through

the recovery and recycling of PW. Recycling is market driven in developing nations there are few material recycling facilities and only a negligible proportion of the waste is recycled (Couth et al., 2012).

There are two different types of recycling processes; closed and open loop recycling. In "Open loop recycling" the material undergoes a chemical change and there is usually the loss of its quality whereas in "Closed loop recycling" the product is recycled at the end of it life into the same product or into a different product without the loss of its inherent properties (Williams Thomas G.J.L et al. 2010).

The concept of industrial ecology is well defined with the help of closed loop material through recycling and reuse of the plastic waste. (Lazarevic David et al. 2010) (Williams Thomas G.J.L et al. 2010) Different types of recycling techniques used for the management of plastic waste provide a unique benefit depending upon the specific location, application and requirement. (S.M. Al-Salem et al. 2009)

Landfill is the least preferred treatment option for all the impact categories added green house gases to the environment. (Murphy Sinnott et al. 2013)

The emission of various green house gases are occurred both upstream and downstream of the waste management systems. Upstream emission is due to the processing of virgin material for the manufacturing of the new products. These types of processes require more fossil fuels energy.

During recycling process various green house gases emit (King Megan F. et al.2013) (Couth R.et al.2012).

Closed loop plastic waste recycling is a better environmental practice that reduces the consumption of virgin resources on the other hand helps in reducing GHG's emission and save large amount of fossil fuels (Haque A., Mujtaba I.M et al. 2000) (Minoru Fujii et al.2012). This approach should be emphasised in a country like India which depend largely on non-renewable resources for the generation of energy.

In addition the recycled material cannot always fully substitute a similar product in the market for several reasons but due to their less price as compare to virgin product it cover the market for middle community in India (Achilias D.S.et al. 2007) (Rigamonti L, et al.2013).

Recycling of the plastic waste depends totally on the source and type of the plastic from where it is generated (Panda Achyut K. et al. 2010). According to the type of the plastic it is being processed and recycled into new products and sometimes direct energy recovery (Al-Salem S.M et al. 2009) (Subramanian P.M. et al. 2000); which ultimately reduces the burden on landfill sites by minimizing the waste generated in the society.
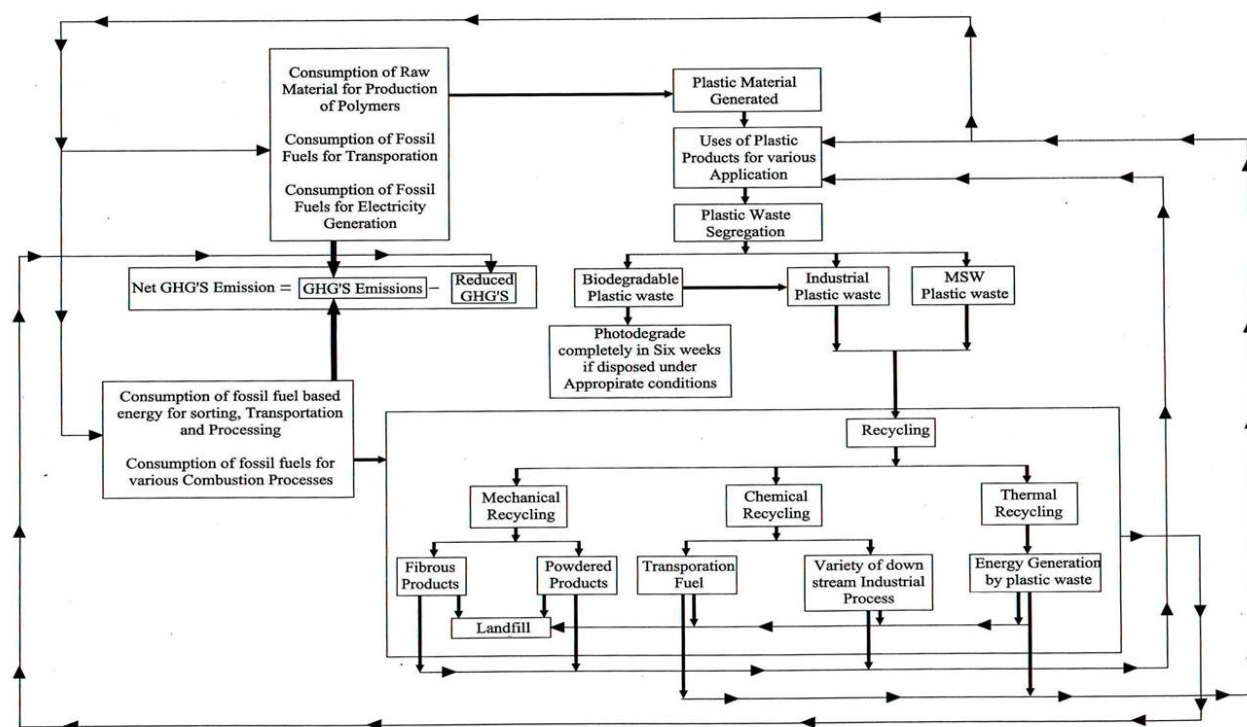

FIG. 1 CONCEPTUAL FRAMEWORK FOR CLOSED LOOP RECYCLING OF PLASTIC WASTE

Successful Recycling of Plastic Waste Using FAST

A functional analysis system technique (FAST) is used to find out the influential factors responsible for successful recycling of PW depends (Mahdavi Iraj et al. 2011) (Shukla Om Ji et al.2013). For a FAST analysis we first determine the causes and then its effects too. The operational efficiency of the recycling system depends upon the active participation of public,professional experts and skilled labour. In developing nations there are lack of environmental analysis and control system for calculate the real impacts.
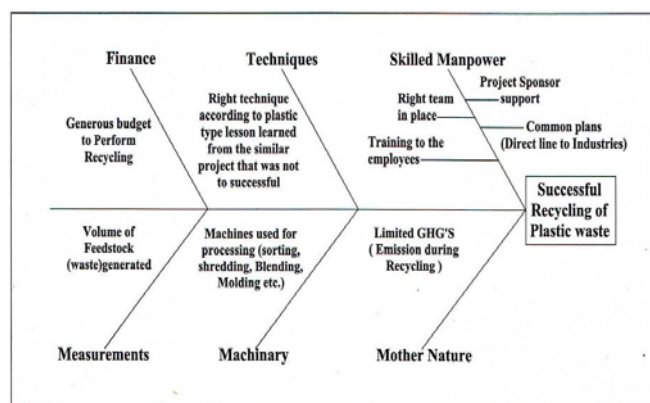

FIG. 2 VISUALIZATION OF CAUSES AND EFFECTS DURING RECYCLING OF PLASTIC WASTE USING FAST

The government should encourage the market for the recycled products and provide financial assistance for the development of infrastructure for recycling units and helps to organize informal sector (Guerrero Lilliana Abarca et. al.2013)

Proposed Model for Cross Functional Team for Successful Recycling and management of Plastic Waste
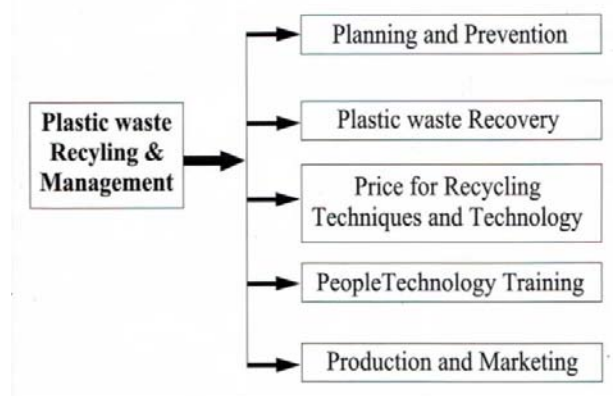

FIG. 3 PROPOSED MODEL OF CROSS FUNCTIONAL TEAM FOR THE RECYCLING AND MANAGEMENT OF PLASTIC WASTE

Successful management policies can be designed with

the availability of the reliable data, trained manpower, infrastructural development, institutional and administrative arrangements, implementing legal policies, financial and technical facilities and corporation of private operators. Major problem to handle plastic waste in India is the difference in its geographic locations, climatic variation, social differences and the level of economic development within the nation (Issam A. Al-Khatib et al.2010).

The different parameters considered for successful management planning of recycled plastic waste are closely connected with five P's:

Planning and Prevention

In India local municipalities are responsible for the implementation of various rules and for any infrastructure development for the collection, storage, segregation, transportation of the waste generated (Talyan Vikash et al. 2008).

There must be some program initiation at national level which support and promotes the organization of informal recyclers, to improve their working conditions, increase the opportunities for social and economic inclusion. The expansion of selective collection services in the country through employment of the informal cooperative sector (King Megan F. et al.2013).

There must be policies that support recycling programs for the developing nation because they are continuously struggling to expand recycling management services to the entire population and lack of physical and human resources.

Plastic Waste Recovery

Plastic waste must be sourced and processed within a radius of 200 km from the recycling facilities (Couth et al., 2012). In the developing nations the recovery of plastic waste takes place through a complex chain comprising of workers involved in informal sector. This includes rag pickers, Small middleman (known as kabaris), itinerant waste collector and big waste traders. There must be reorganization of the waste pickers through policies and laws made by the government as their work if virtually free for the municipality.

Price for Recycling Techniques and Technology

There is an urgent need to strength the donor funds

for PW to more focus on the treatment facilities, operational cost and recycled units (] Issam A. Al-Khatib et al.2010). Regional differences, transportation cost land price drive up the cost for establishing recycling units. Conduct regular monitoring to evaluate the effectiveness of the strategy and make changes as required; review and update the plan every few years to ensure the system remains in regulatory compliance and to make continual improvements. Clearly such knowledge is must in order to form the base for policy recommendations.

People Technology Training

Concerning staff is the serious issue is how the overall management is handled as there is no person with the proper academic training and professional experience required for handling soild waste management in India (] Issam A. Al-Khatib et al.2010). Proper segregation of the plastic waste and use of appropriate technology can reduce the environmental burden and replaces virgin material with recycled products. Additional staff is needed to cover the services. However due to economic difficulties; this cannot be supported.

Production and Marketing

Once the waste is generated recycling is the better environment practice. In recycling it is required to take into account the material loss that occur during recycling processes (Friedrich Elena et al.2013). The two parameters (Rigamonti L, et al.2013) (Agarwal Ankit et al.2005) that must considered while recycling of the plastic waste are:

1. The amount of the output which is specified as a percentage of the material input.

2. The market substitution value to avoid the excessive production of the recycled materials because they cannot always fully substitute a similar product in the market.

Political interference, economical diversification, and urban rural migration rate directly impact the recycling market.

Conclusions and Recommendations

The plastic waste recycling technologies can contribute greatly to the change the existing image of plastic waste management, recycling, treatment and recovery. Social and economic benefits of recycling include employment opportunities from collection to manufacturing, which are important source of the income for the poor communities of the developing nation. Recycling also conserve the capacity and extend the lifespan of landfills. The use of the plastic waste as a recycled product reduces the cost of final product and less depletion of natural resources; hence reduces environmental burden globally.

The following are the recommendation for the successful recycling for the plastic waste:

1. Improvement of the recycle system through the creation of effective information exchange network and ensure the upgrading and consistency of the recycled products.

2. Number of factors involved in the planning phase for recycling of PW that include rag pickers, political bodies, local authorities and central government and stakeholders. By formulating and continually reviewing a project plan helps to minimize the chances of the losses due to market uncertainties regarding the production of recycled products.

3. The developing nations must understand that how plastic materials that would otherwise become waste can be more sustainably managed throughout the economy. Managing materials efficiently require action by government and the private sectors will help sustain the low-energy economy.

However huge quantity of the plastic waste is being recycled in India, but there is an urgent need to capture the whole scenario of its recycling, either quantitatively and qualitatively which would help the government set up a healthy recycling strategy.

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